Tank Farm Soils

Legend

— Roads and Buildings
—×— Fences
▢ Buildings
▢ Underground Tanks
▨ CPP-96 Boundary
■ CPP-28, CPP-31
■ CPP-15
■ CPP-26, CPP-79
■ CPP-24, CPP-30, CPP-33
■ CPP-16, CPP-20, CPP-25, CPP-27, CPP-32, CPP-58
▨ Potential Abandoned Shoring Devices

1. North and east of WM-180 and WM-181
2. North of WM-182 and WM-183
3. East of WM-186
4. Between WM-184 and CPP-604
5. North of the Main Stack

Project: OU 3-14
Map Requestor: Cindy Klassy
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Date Drawn: 04/14/2004
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Path: X:\gis_projects\cpp\tank_farm_soils
File Name: tank_farm_base_map-bl_v3.aml.mxd

Figure 3-43. Potentially abandoned shoring devices remaining from upgrades to the tank farm.

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3.1.14.2.3   Residual Contamination in Backfill—As described in previous sections, soil having low levels of radioactivity was used to backfill excavations. This contaminated backfill may pose a risk to groundwater if contamination exists in sufficient concentrations and the volume of contaminated soil is large enough. Therefore, the following data are necessary in determining an overall source term for the contaminated backfill:

1.   Average soil radionuclide concentration for Cs-137

2.   Actual volumes of soil used as backfill for the various tank farm projects.

Determining a conservative average Cs-137 concentration in the soil would be the first step in developing a bounding source term for the contaminated backfill. Limited analytical data were found during the data-mining process for the soil used as backfill. This was probably because field radiation detectors were used to segregate soils by activity levels over the course of excavation and construction. However, data exist that will allow an average Cs-137 concentration to be determined. Eleven contaminated soil samples from the contaminated soil stockpile generated as a part of the HLWTFU project were collected and analyzed in 1995 for radionuclides. The Cs-137 concentrations ranged from 3.81 to 114 pCi/g and the average Cs-137 concentration was 34.0 pCi/g. Boreholes installed through backfill material also helped characterize the backfill material. The soil boring at CPP-79-1 had Cs-137 concentrations ranging from 0.5 to 20.9 pCi/g in the upper 36 ft where the less contaminated soil was used as backfill. In borehole 27-2, drilled to a depth of 12 ft bgs in the backfill, the Cs-137 concentrations ranged from 1.08 to 54.0 pCi/g. TFR-3 was drilled to a depth of 14.25 ft within backfill material, northeast of the CPP-33 release site. No measurable radiation was detected in the field screening of soil samples, and the Cs-137 concentration for the 10.25- to 14.25-ft interval soil sample was 0.27 pCi/g. The maximum radiation reading in boreholes #7 and #8 located at the CPP-27 release site was 1,000 cpm, which demonstrates relatively low concentrations of radionuclides in the backfill. Based on these data, using the maximum Cs-137 value of 114 pCi/g would conservatively bound the contaminated backfill.

The actual volume of contaminated backfill used at the various excavation and construction sites across the tank farm over its period of operation was not well documented. Volumes of soils removed from excavations for disposal outside the tank farm were documented and are presented in Table 3-13. Because actual backfill volumes are not known, an alternate approach to determining risk from backfill was used. The maximum number of curies from Cs-137 and Sr-90 that could reside in the tank farm backfill and not contribute to the overall risk was estimated. Based on the total Cs-137 and Sr-90 curies estimated for each release site (see Table 3-1), the total Cs-137 and Sr-90 activity (lower limit) was 28,373 Ci. Assuming that most of the curie totals were from measurements made in the 1970s, approximately one half-life has occurred, reducing the total to approximately 14,000 Ci. One-half of one percent (0.5%) of that total equals approximately 70 Ci of combined Cs-137 and Sr-90 (sites with less than 1% of the total curies were not considered a risk to groundwater in the OU 3-13 BRA).

Using a maximum recorded backfill concentration of 114 pCi/g for Cs-137 and assuming the same for Sr-90 results in a combined Cs-137 and Sr-90 concentration of 228 pCi/g. Using this concentration, the 70-curie upper boundary and 125 lb/ft^3 soil weight, a volume of soil containing this activity was determined to be 5,410,000 ft^3. This volume represents a rectangular excavation 375 ft by 480 ft (180,000 ft^2) and a typical excavation depth of 30 ft. The area of the tank farm is approximately 375 ft (north to south) by 515 ft (east to west) (193,125 ft^2) and using an excavation depth of 30 ft yields a volume of 5,793,750 ft^3. This volume contained in the tank farm area includes considerable infrastructure, including the estimated portion of the tank vaults in the upper 30 ft (682,000 ft^3), valve boxes, piping, etc. (Table 3-14). Comparing these volumes, the amount of soil determined by the bounding calculations (5,410,000 ft^3) represents 106% of the upper 30 ft of the tank farm soil (511,839 ft^3). As a result, the

Table 3-14. Comparison of the bounding estimate of contaminated backfill volume and tank farm volume.

Description	Volume (ft^3)	Area (ft^2)	Depth (ft)
Bounding contaminated estimate	5,410,000	180,000 (375 ft × 480 ft)	30
Tank farm (physical volume to 30 ft)	5,793,750	193,125 (375 ft × 515 ft)	30
Tank farm (top 30 ft) minus tank vault volume (682,000 ft^3)	5,111,750	193,125 (375 ft × 515 ft)	30

entire tank farm could be excavated to an average depth of 30 ft and backfilled with contaminated soil at 228 pCi/g Cs-137 and Sr-90 and remain at 0.5% or less of the total estimated curie inventory of the tank farm (70 Ci). The conservativeness of this estimate is further exemplified by the following:

- The volume of backfill, determined by the bounding calculations, overestimates what could have physically been excavated from the tank farm.

- Typically, excavated soil was used as backfill in the lower depths of an excavation. This soil inventory has already been accounted for in the individual release site inventories determined from process knowledge.

- Typically, as much as 10 ft of clean soil was used in the top portion of an excavated area as per standard operating procedure to reduce worker exposure.

3.1.15 Suspect Piping

Due to the high numbers of piping runs and different designs used to transfer waste within the Tank Farm Facility, piping integrity becomes an important consideration in the RI/FS process. Some piping/encasement designs proved to be very reliable over the years of operation; others did not. Generally, the stainless-steel pipe-in-a-pipe design has been trouble-free, with both the inner and outer material being compatible with the acidic wastes. The stainless-steel-lined concrete-trough system has also experienced few problems. The split-tile- and split-steel-encased lines, on the other hand, had secondary containment problems due to incompatibility with the acidic waste and/or structural stability. Additionally, carbon-steel lines installed in the tank farm had the potential to come into contact with waste via valves that were improperly set, which could cause corrosion.

Based on the release mechanisms of the known release sites, it can be generally concluded that the larger releases were a result of using carbon-steel piping at inappropriate locations, containment failure of split-tile or split-steel encasements, or valve leaks associated with the split-tile or split-steel encasements. The use of split-tile encasement was limited to waste-transfer lines associated with the construction of tanks WM-180 and -181. Therefore, the area between the CPP-604 tank vault and WM-180 and -181 was generally the only area within the tank farm to use the split-tile encasement. Because this area has been excavated extensively during tank farm improvement projects, any significant releases associated with the piping would have most likely been discovered. Tanks WM-180 and -181 both have short sections of split-tile-encased stainless steel lines on the north side of the tanks. These lines were originally stubbed out of the tank and capped for future use. Two lines, one on each tank, were subsequently connected to the waste transfer system and used to handle waste (Figure 2-16). Strict administrative controls were placed on these lines to minimize their use, reducing the risk of release (see Section 2.4.4.1). Because a

short section of split-tile encasement has been used, the piping was listed as suspect. However, no known leaks or unusual occurrences are associated with the use of these two lines, and releases were unlikely.

The split-steel encasement also had limited use in the same area between the CPP-604 tank vault and WM-180 and -181. Approximately 160 ft of the piping/encasement was used and has since been abandoned or removed. The excavation activity in the area where the piping was used would have uncovered any leaks in addition to the one discovered at CPP-28.

The largest contaminant release within the tank farm has been the release at CPP-31, where a carbon-steel drain line came into contact with acidic waste solution. The intended use of the line was a drain line for cooling water in the event cooling water became contaminated. An incorrectly positioned valve allowed waste solution to back into the carbon-steel drain line, causing corrosion and failure of the line. Because of this piping configuration, tank farm personnel checked all of the piping flow sheets in 1975 for the entire tank farm to determine whether other previously unsuspected leak mechanisms exist. Particular attention was paid to interfaces with encased waste-transfer lines. One connection of a carbon-steel line to a transfer line from WM-181 to the dilute waste evaporator feed tank was discovered. This line was disconnected, and a blind was installed on the stainless-steel line (Allied Chemical 1975a).

In summary, waste transfer piping having the inferior encasement designs serviced only small portions of the tank farm. Only a few carbon-steel lines were identified that had the potential to come into contact with corrosive liquid wastes, but these were located in areas that have already been excavated. Those short sections of piping still employing the split-tile encasement have had strict administrative controls limiting their use.

3.1.16 Summary of Operable Unit 3-14 Site Contamination

Based on past field investigations and process knowledge, a Cs-137 and Sr-90 Ci inventory was determined for each release site, as discussed in previous sections. The curie inventory is summarized in Table 3-15. The inventory is based on Cs-137 and Sr-90 activities using the time of release or soil sample dates, depending on how the inventory was determined. Other radionuclides were not considered in the inventory because of their short half-lives or low-activity levels. Ce-144, for example, contributes to the early overall activity of waste. Because of its relatively short half-life of 284.6 days, however, it decays relatively quickly and is not a concern after a few years. In determining the curie content for some of the waste streams, only the Cs-137 activity was measured. In those cases, the Sr-90 activity was assumed to be the same as the Cs-137 activity.

The Cs-137 and Sr-90 activity inventory for each release site was estimated either by using process knowledge or past field characterization data. Process knowledge was used for releases where the volume of a defined waste stream was known. A Cs-137 and Sr-90 waste stream activity was determined by looking up waste analytical results for the time of release in appendix data tables that are presented in the 2003 calcined waste inventory report (Staiger 2003) or in PEW evaporator condensate analytical data reports for the time of release. By knowing the volume released and associated activity, a release inventory could be calculated.

In the case where the volume of a release was unknown, field characterization data were used. A volume of contaminated soil was estimated by using the reported footprint of the release site multiplied by the thickness of the contaminated soil body. Laboratory analytical results for soil samples collected at each particular site were used to calculate an arithmetic mean value of the Cs-137 and Sr-90 activities. The mean values were then used with the volume to develop a Cs-137 and Sr-90 inventory for the respective release site.

Table 3-15. Estimated curies remaining at CPP-96 release sites.

Site	Method Used to Estimate Amount of Cs-137 and Sr-90 Activity Remaining												Curies Remaining	
	Process Knowledge					Field Characterization							Estimated Cs-137 and Sr-90 Curies Remaining at Release Site	Date Estimate Applies
	Volume Released (gal)	Type of Waste	Curie Content of Liquid[a] (Ci/gal)	Curies (Year of Release)	Excavation of Contamination	Area of Contamination (ft²)	Thickness of Contamination (ft)	Volume of Contamination (ft³)	Lowest Cs-137 Activity in Soil (pCi/g)	Highest Cs-137 Activity in Soil (pCi/g)	Arithmetic Mean Cs-137 Activity to Calculate Curies in Soil (pCi/g)	Year Sample Collected		
CPP-15	Unknown	Radioactive spent solvent/ other	Unknown	NA (1974)	1974 partially removed	700	20	14.000	44.5	586.000	293.022	1995	466b	1995
CPP-16	3,210	95% Diverted service waste, 5% PEW bottoms	PEW bottoms – 0.275 Ci/gal Service waste – 0.0003 Ci/gal	40.7 (1976)	Incomplete excavation records								40.0	1976
CPP-20	Unknown amounts of small spills	Acidic radiologi- cal waste for PEW	Unknown	NA	1982, 1983, 1984 contamination removed	205.5	28	5,754	3.81 (Sr-90 – 6.6)	114 (Sr-90 – 330)	114 (Sr-90 – 330)	1995	0.145	1995
CPP-24	1.0	1st cycle	30 (estimated)	30 (1954)	1954 contamination removed								<	NA
CPP-25	Unknown	PEW	Unknown	NA (1960)	1960, 1982, 1984 -1984 contamination removed	350	28	9,800	3.81 (Sr-90 – 6.6)	114 (Sr-90 – 330)	114 (Sr-90 – 330)	1995	0.247	1995
CPP-26	15	1st cycle	8.0	120 (1964)	1964 contamination partially removed								120	1964
CPP-27	Unknown	WCF decontami- nation and recycle waste; possibly stack condensate	Unknown	NA	1974, 1983 contamination partially removed	2000	25	50,000	0.12	1370	214	1992	1.2b	1992
CPP-28	120	1st cycle	6.0	720 (1974)	Half of contamination removed								360	1974
CPP-30	Unknown	1st cycle	Unknown	NA	1974 contamination removed								<1	1974

Table 3-15. (continued).

| | Method Used to Estimate Amount of Cs-137 and Sr-90 Activity Remaining | | | | | | | | | | | | Curies Remaining | |
| | Process Knowledge | | | | Field Characterization | | | | | | | | Estimated Cs-137 and Sr-90 Curies Remaining at Release Site | Date Estimate Applies |
Site	Volume Released (gal)	Type of Waste	Curie Content of Liquid[a] (Ci/gal)	Curies (Year of Release)	Excavation of Contamination	Area of Contamination (ft²)	Thickness of Contamination (ft)	Volume of Contamination (ft³)	Lowest Cs-137 Activity in Soil (pCi/g)	Highest Cs-137 Activity in Soil (pCi/g)	Arithmetic Mean Cs-137 Activity to Calculate Curies in Soil (pCi/g)	Year Sample Collected		
CPP-31	14,000	2nd cycle, 3rd cycle, evaporator bottoms	1.70	23,800 (1972)	No soil removal documented								23,800	1972
CPP-32 West	4.2	Tank vault sump liquid	2.42 x 10⁻³	(1976)	Partially removed								0.02	1976
CPP-32 East	Unknown	1st cycle condensate	Unknown	NA (1976)	Partially removed	14	5	70	133	277	209.5	1992	0.0017	1976
CPP-33	Unknown	WCF decontamination and recycle waste	Unknown	NA	1983 contamination removed	1,200	30	36,000	3.81 (Sr-90 – 6.6)	114 (Sr-90 – 330)	114 (Sr-90 – 330)	1995	0.91	1995
CPP-58E	20,000	PEW condensate	1.40 x 10⁻⁷	0.0028	1976								0.0028	1976
CPP-58W-1954	360	10% PEW condensate	7.2 x 10⁻⁷	2.66 × 10⁻⁵ 1954	No excavation or removal reported								2.66 × 10⁻⁵	1954
CPP-79-Shallow[c]	1,830 (WCF) / 682 (NWCF)	Dilute calciner decontamination solutions	0.0038 / 0.000008	7.0 (1986) / 0.005 (1986)	1994 contamination partially removed								7.0	1986
CPP-79-Deep[d] Lower Limit[e]	634	1st cycle	6[f]	3,804 (1970)	None	707	6.0	1,414					3,804	1970
CPP-79-Deep[d] Upper Limit[g]	2,256	1st cycle	6[f]	13,535 (1970)	None	1,257	12	5,027					13,535	1970
Totals												Low estimate	28,600 Ci	
												High estimate	38,331 Ci	

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Table 3-15. (continued).

	Method used to Estimate Amount of Cs-137 and Sr-90 Activity Remaining													Curies Remaining	
	Process Knowledge						Field Characterization								
Site	Volume Released (gal)	Type of Waste	Curie Content of Liquid[a] (Ci/gal)	Curies (Year of Release)	Excavation of Contamination	Area of Contamination (ft²)	Thickness of Contamination (ft)	Volume of Contamination (ft³)	Lowest Cs-137 Activity in Soil (pCi/g)	Highest Cs-137 Activity in Soil (pCi/g)	Arithmetic Mean Cs-137 Activity to Calculate Curies in Soil (pCi/g)	Year Sample Collected	Estimated Cs-137 and Sr-90 Curies Remaining at Release Site	Date Estimate Applies

a. Curie content based on Cs-137 and Sr-90 activities of waste analyses performed on appropriate waste at the time of the release.

b. Curie content at time of release based on Cs-137 activity. Sr-90 was assumed to have the same activity at the time of release. Actual sample analysis for Sr-90 activities, where available, is typically less due to the more mobile nature of strontium. Source of contamination may include stack condensates requiring different radionuclide ratios if a release volume can be determined in the OU 3-14 RI.

c. Two waste streams combined to create this release: 1,830 gal from the WCF at 0.0038 Ci/gal and 682 gal from NWCF at 0.000008 Ci/gal.

d. CPP-79-Deep only has one sample point at 32 to 33.3 ft bgs. Therefore, a high and low estimate are provided to help bound the release.

e. Lower limit: assumes the waste formed a half oblate-dome configuration (30-ft diameter by 6-ft height) due to the existence of the CPP-604 tank vault and does not exist all the way to bedrock, resulting in a volume of 1,414 ft³. Using a 6% soil moisture equivalent results in a volume of 634 gal.

f. Curie content of first-cycle waste based on average Cs-137 activities measured during operation from the late 1960s and early 1970s. The activity of Cs-137 was doubled to account for Sr-90 activity.

g. Upper limit: assumes the waste infiltrated the soil from the release point down to basalt. The shape of the contaminated zone is again a half-oblate dome, with a diameter of 40 ft and a height of 12 ft, resulting in a volume of 5,027 ft³. Using a 6% soil moisture equivalent results in a volume of 2,256 gal.

NA- Not applicable.

--- Information unknown or not applicable.

Text   --- Information known but not used in determining estimated curies remaining.

The updated release site curie inventory presented in Table 3-15 was used to help rank individual release sites in terms of significance. Using the lower limit value for CPP-79-Deep in the total remaining value for Cs-137 and Sr-90 activity resulted in 28,373 Ci. Four sites—CPP-15, -28, -31, and -79-Deep—contribute 99.8% of the total. CPP-31 is by far the biggest contributor, with 23,800 Ci, or 83.9%, of the total. CPP-79-Deep is estimated to be the second-largest contributor, with 3,804 Ci, or 13.4%, of the total. CPP-28 and -15 each contributed 1.3% to the total, with 360 Ci (a total of 720 Ci) of Cs-137 and Sr-90 activity.

During the OU 3-14 remedial investigation, source terms will be developed for each of the release sites to estimate the release inventory of the more mobile radionuclides of concern with longer half-lives including I-129 and Tc-99. The information presented in this Work Plan for each release site provides defensible data in which to calculate release inventories. Once the source terms are developed they will be used in the vadose zone model to better predict the transport of radionuclides downward to the SRPA.

3.2   Other Contributing Sources

Other INTEC sources that will be considered in the OU 3-14 RI/FS include residual contamination in the tanks, sand pads, and RCRA piping, the WCF, which was closed under RCRA, and OU 3-13 sources. In addition, planning for the final end state of other sources at INTEC is in process and these sources are briefly mentioned. How these other contributing sources will be incorporated into the OU 3-14 RI/FS is discussed in Section 4.3.

3.2.1   Tank Residuals

A heel of liquid and solid particles remains in a tank after all possible waste has been removed using existing transfer jets. In each tank at the tank farm, the depth of the heel typically varies from 3 to 10 in. At the tank farm, the solid particles in the heel typically comprise 1 to 4 in. of solids at the bottom of the tank and are likely composed of solids precipitation, lesser amounts of undissolved process solids, and traces of dirt and debris. The balance of the heel is liquid up to the level of the jet suction. During the cleaning phase of the closure, modifications are made to the steam jet system to lower the suction to within an inch (typically less than 1/2 in.) of the tank bottom. Tank cleaning activities are then conducted to remove both the liquids and solids in the heel. Once cleaning is complete, only a small amount of residual material will remain, typically on the order of 1/8 in. or less. Mockup testing has shown that grouting of the tank could remove a significant portion of any remaining liquid, leaving only a small layer of residual solids in the tanks at closure.

As of February 2004, five of the large tanks (WM-182, -183, -184, -185, and -186) have been cleaned. WM-182 had an average residual thickness of ⅛ in. after cleaning, while WM-183, -184, -185, and -186 all had residual thicknesses of ⅛ in. or less. The tank cleaning process has proven to be successful, and the remaining tanks, all similar to the first five in terms of access and construction, should not pose any new cleaning problems. When an estimate of the tank residuals and end state of the tanks is required for the OU 3-14 RI/FS, a current estimate will be used.

3.2.2   Sand Pad Contamination

The sand pads under tanks WM-185 and -187 are contaminated from accidental releases into the vaults in 1962. A description of the leakage into the tank vaults is available in Latchum et al. (1962). When an estimate of the residual contamination in the sand pads is required for the OU 3-14 RI/FS, a current estimate will be used.

3.2.3 Residual Contaminant Inventory in RCRA Piping

Residual metal and radionuclide contamination remains in process waste piping. Current planning is for piping to be closed in place in accordance with 40 CFR 265.197 (a) (clean closure) or (b) (landfill closure) as part of the RCRA closure of the tanks. A current estimate of residual contamination in RCRA piping will be used in the OU 3-14 FS.

3.2.4 Other INTEC Facilities

A number of other INTEC facilities could be a potential source of contamination to groundwater. The WCF was closed under RCRA. The facility was entombed in place. Because the end state of this INTEC facility is known, it is reasonable to include the closed facility in the INTEC groundwater model as a potential source. The end state of other facilities at INTEC have yet to be decided, such as CPP-601, -603, -604, and -605. A mechanism to estimate the potential impact of these sources to groundwater using a simplified groundwater model is being developed as a planning tool. Its use under OU 3-14 will be discussed in Section 4.3.

3.2.5 OU 3-13 Sources

The OU 3-13 RI/FS examined the impact of OU 3-13 soils, which included the tank farm soils and the former INTEC injection well, on the Snake River Plain Aquifer. The OU 3-13 ROD selected an interim action for the Snake River Plain Aquifer inside the INTEC fence and deferred the evaluation and decision on the final action to OU 3-14. Because OU 3-14 must determine cumulative baseline risk to groundwater from OU 3-13 sources and determine the final action for groundwater inside the INTEC fence, OU 3-13 soils and the former injection well must be included in the OU 3-14 groundwater model. Because no decision will be made under OU 3-14 on a remedy for sites located outside the OU 3-14 boundary, no further characterization will be done for those sites. In OU 3-13, the tank farm soils represented 95% of the contaminant source term to the Snake River Plain Aquifer and did not pose an unacceptable risk. The OU 3-13 soil sites will be included in the INTEC groundwater model to determine the cumulative baseline risk of OU 3-14 tank farm soil sites combined with the OU 3-13 sites. The former injection well was transferred back to OU 3-13 through the ESD (DOE-ID 2004a) and is being investigated and monitored under OU 3-13. New OU 3-13 sites have been identified since the OU 3-13 ROD, such as CPP-84 and CPP-94, and these will be incorporated into the INTEC groundwater model.

3.3 OU 3-13 Risk Assessment Summary

The OU 3-13 Remedial Investigation/Baseline Risk Assessment (RI/BRA) (DOE-ID 1997a) determined which WAG 3 sites have contamination at levels likely to adversely affect human health and the environment. The OU 3-13 BRA evaluated the nature and extent of contamination. The site screening determined which sites to eliminate from further evaluation based on acceptable levels of residual contamination or previous No Action/No Further Action determinations. Contaminant screening was performed on the sites that were carried over (see Table 7-1 in the OU 3-13 ROD [DOE-ID 1999a]). Contaminant fate and transport modeling was conducted, and risks associated with available and site-related contamination data for the WAG 3 release sites were estimated based on data and conceptual models available at the time. Sites with contamination above acceptable limits were carried over to the OU 3-14 investigation.

The OU 3-14 contaminants of potential concern (COPCs) identified for both the soil and groundwater pathways are derived from the OU 3-13 COPCs developed for each release site, process knowledge, and perched water and groundwater data. For this reason, a summary of the OU 3-13 risk assessment is presented.

The OU 3-13 Remedial Investigation (DOE-ID 1997a) presented the available data for WAG 3 concerning site conditions and the nature and extent of contamination as of 1997. The remedial investigation examined 92 of the 94 designated release sites known at the time (CPP-84 and -94 were not investigated in the RI/BRA) for human health and ecological receptors. Because the OU 3-14 risk assessment consists of the tank farm surface soil pathway and the groundwater pathway within the INTEC security fence, only the applicable portions of the OU 3-13 RI/BRA are summarized here. A summary of the OU 3-13 human health baseline risk assessment is given in Table 3-16.

Table 3-16. OU 3-13 human health baseline risk assessment summary for tank farm soils and groundwater.

| Group | COC | Half-life[a] | Exposure Scenario Excess Risk of Incurring Cancer | | |
			Current Worker	Future Worker (in 2095)	Future Resident (in 2095)
Group 1—INTEC Tank Farm[b]	Cs-137[c]	30	6 in 10	6 in 100	3 in 10
	Sr-90[d]	29	5 in 10,000	5 in 100,000	2 in 10,000
	U-235	10^9	5 in 10,000	5 in 10,000	2 in 1,000
Group 5 – Snake River Plain Aquifer[b,e]	Am-241	432	NR[f]	NR[g]	4 in 2,000,000[h]
	Cs-137	30	NR[f]	NR[g]	4 in 1,000,000[h]
	I-129	1.57×10^7	NR[f]	NR[g]	2 in 100,000[h]
	Np-237	2.1×10^6	NR[f]	NR[g]	8 in 1,000,000[h]
	Sr-90	29	NR[f]	NR[g]	9 in 1,000,000[h]

a. Half-life (in years) used in modeling for OU 3-13 risk assessment.

b. Pu, which primarily originates from the tank farm soils, is predicted to exceed SRPA MCLs and pose a groundwater ingestion risk in the year 2750. Pu is not predicted to exceed MCLs or pose a risk in 2095. Refinement of those predictions and remediation, if necessary, will be addressed in the OU 3-14 RI/FS.

c. Cs-137 contributes to risk only via direct exposure.

d. Sr-90 contributes to risk via groundwater, soil direct exposure, and ingestion.

e. Although workers drink SRPA, the drinking water wells do not intersect the plume.

f. No risk.

g. No risk to future worker if institutional controls remain in place or water treatment is implemented.

h. These values are predicted risk to future residential in 2095 and beyond. Cumulative groundwater risk to future residential in 2095 and beyond is 5 in 100,000 outside the current INTEC security fence. Risk calculations on future impacts inside the current INTEC security fence will be refined under the Tank Farm RI/FS (OU 3-14).

3.3.1   Summary of the OU 3-13 Tank Farm Surface Soil Pathway

The results of the OU 3-13 RI/BRA indicate that the potential exists for adverse health effects from exposure to the tank farm soils contaminated with Cs-137, Eu-154, U-235, and Sr-90. Site characterization was limited during the OU 3-13 RI/FS (DOE-ID 1997a, 1997b), primarily because the tank farm is an active operational facility. Assumptions about the horizontal and vertical distribution of contaminated soils were made to calculate the area-weighted soil concentrations; however, the boundaries of the release sites were not well known. Assumptions about the concentration in the perched water were of concern, because perched water may contribute to elevated concentrations in the SRPA. The OU 3-13 Feasibility Study Supplement (DOE-ID 1998c) presented important tank farm soil characteristics such as the contaminated area, OU 3-13 COCs, preliminary remediation goals (PRGs), and the required period of performance for each site. The characteristics are summarized in Table 3-17.

Table 3-17. Summary of OU 3-13 tank farm surface soil release sites, OU 3-13 COCs, and PRGs (DOE-ID 1998a).

Release Site	Area[a] (ft²)	Major COCs	PRG (pCi/g)	Time Required to Achieve PRG[b] (years)
CPP-15	700	Cs-137	23	443
CPP-20	225	Cs-137	23	173
CPP-25	500	Cs-137	23	173
CPP-26	12,850	Cs-137	11.5	360
		Sr-90	111	120
CPP-27/33[c]	2,000	Cs-137	23	293
CPP-28/79[d]	4,950	Cs-137	4.6	781
		Eu-154	1,040	172
		Pu-238	134	880
		Pu-239/240	50	137,000
		Pu-241	11,200	174
		Sr-90	44.5	464
CPP-31	10,550	Cs-137	4.6	575
		Pu-239/240	50	50,800
		Sr-90	44.5	268
		U-235	2.6	6.4 billion
CPP-32[e]	14	Cs-137	23	223
CPP-58[f]	6,800	Cs-137	23	147
CPP-96 (additional soils)[g]	79,696	Unknown	Unknown	Unknown

a. All of the release-site areas were obtained from the OU 3-13 RI/BRA (DOE-ID 1997a, Figures 9-1 and 10-1) except for the contaminated soil stockpile, which was surveyed, and the area of additional soils, which was estimated in the OU 3-13 feasibility study (DOE-ID 1997b).

b. The time required to achieve the PRGs, which are risk-based concentrations (RBCs), was obtained from interdepartmental correspondence from D. E. Burns to R. D. Greenwell, Lockheed Martin Idaho Technologies Company, January 31, 1997. This column refers to the amount of time required for the COCs to decay naturally to an activity less than the 1E-04 RBC. The RBC corresponds to a concentration that yields a 1E-04 incremental lifetime cancer incidence risk.

c. Sites CPP-27 and -33 are considered together, because they were derived from the same transfer line leak and were considered together in the OU 3-13 RI/BRA and all Track 2 investigations.

d. Sites CPP-28 and -79 are considered together, because an area of high concentration that probably originated from site CPP-28 is contained within CPP-79.

e. This site was formerly designated as CPP-32W. It was combined with a similar site, CPP-32E, and designated as CPP-32.

f. This site is designated as CPP-58E and -58W, which represent the eastern and western portions of the CPP-58. The eastern portion originated from a spill, and the western portion originated from a leak, both from the same source.

g. Site CPP-96 refers to surface soils surrounding the tank farm vaults that are assumed to be contaminated because of the uncertainty in the tank farm site characterization. The volume of additional soils was estimated using the excavation footprint shown in the OU 3-13 feasibility study (DOE-ID 1997a, Figure 5-1) less the volume occupied by the tank vaults and the soil volumes at known release sites. The soils surrounding the tank vaults were assumed to be contaminated to a depth of 40 ft.

As shown in Table 3-17, the primary risk contributors (i.e., the OU 3-13 COCs) identified in the OU 3-13 RI/BRA for the tank farm surface soils were Cs-137, Eu-154, Pu-238, Pu-239/240, Pu-241, Sr-90, and U-235. Though plutonium did not present an unacceptable risk, it was added to the OU 3-13 COC list because of uncertainty about the amount of plutonium released in the tank farm area. The uncertainty in the distribution of contaminants in the surface soils stemmed from the lack of documentation of all of the potential historical contaminant releases at the tank farm, limited site characterization during the OU 3-13 field investigation, and uncertainties regarding backfill materials used following excavations.

3.3.2   Summary of the OU 3-13 Groundwater Pathway Modeling and Risk Assessment

There are two sources of existing or future contamination in the SRPA. These consist of (1) the historical use of the injection well and (2) surface-soil sources leaching through the vadose zone into the perched water and subsequently into the SRPA. The OU 3-13 BRA simulated the vadose zone/aquifer/groundwater system at INTEC. Simulations were performed to predict water infiltration and transport through the vadose zone. The predicted water and contaminant mass fluxes from the vadose zone model were then used as input to a separate aquifer model.

Predictions of contaminant transport from land surface to the SRPA and south to the INEEL boundary were focused on obtaining future groundwater concentrations in the year 2095. These predictions were used to support the 100-year risk scenario (DOE-ID 1996) for the WAG 3 comprehensive BRA (DOE-ID 1997a) and to evaluate potential health impacts to a hypothetical future resident.

The risks calculated for the SRPA are risks on the INEEL Site. No projections of impact off of the INEEL Site have been completed for downgradient SRPA users. Concentrations were reported as a function of time over a simulation period extending well beyond 2095 until the peak concentrations were identified. In the contaminant transport analysis of groundwater, all tank farm release contaminants were assumed to move immediately from the surface soil to the underlying basalt after release from a tank farm facility. This assumption was conservative for the groundwater pathway, because the assumption maximizes concentrations and reduces transit time.

The determination of the OU 3-13 COPCs for the groundwater pathway is discussed in Section 5.2 of Appendix F of the OU 3-13 RI/BRA (DOE-ID 1997a). Table 3-18 presents the OU 3-13 COPCs that were evaluated for the groundwater pathway. These include the three nonradionuclides (arsenic, chromium, and mercury) and the 10 radionuclides (Am-241, Co-60, Cs-137, H-3, I-129, Np-237, Sr-90, Tc-99, total plutonium, and total uranium). These originate either at the land surface (current soil inventory), historical waste process water discharge streams (i.e., service waste ponds or percolation ponds), accidental releases, and/or past use of the INTEC injection well (site CPP-23). The injection well source includes the period during which the well failed and introduced contamination to the vadose zone rather than the SRPA. In addition, because the Test Reactor Area and INTEC contaminant plumes could overlap downgradient, the two primary contaminants identified in the Test Reactor Area remedial investigation (chromium and H-3) were included as SRPA source terms.

Table 3-18. Summary of the identified groundwater COPCs for OU 3-13 (DOE-ID 1999b).

OU 3-13 COPCs Based on Water Samples

COPCs Based on the SRPA	Additional COPCs Based on Perched Water	Additional COPCs Based on Soil Contamination	Additional COPCs Based on Other Considerations	Final List of the COPCs for the Groundwater Pathway
Am-241	None	Arsenic	Cs-137	Arsenic
H-3		Chromium	Mercury	Chromium
I-129		Co-60		Mercury
Np-237		U-235[a]		Am-241
Sr-90		Pu-238[a]		Co-60
Tc-99		Pu-239[a]		Cs-137
U-234[a]		Pu-240[a]		H-3
U-238[a]				I-129
				Np-237
				Total plutonium[a]
				Sr-90
				Tc-99
				Total uranium[a]

a. The isotopes were identified as COPCs, but, in the OU 3-13 modeling, they were lumped together and simulated as totals.

Concentrations were reported as a function of time over a simulation period extending well beyond 2095 to identify peak concentrations. The OU 3-13 BRA determined a simulation time of 3,804 years when the peak total plutonium concentration was identified (in the year 3585). Table 3-19 summarizes the maximum and peak concentrations at various periods. Based on the information in this table, the following conclusions can be drawn:

- Arsenic, Co-60, Cs-137, Tc-99, total uranium, and Am-241 were not expected to exceed their MCL and risk-based concentrations (RBCs) (target risk = 1E-04). Recent monitoring in a new well (ICPP-MON-230) located immediately north of the tank farm has detected Tc-99 at concentrations exceeding the MCL. Continuing investigations are under way to determine the source release and extent of the Tc-99 in the SRPA at this well. The ratios of mobile isotopes indicate that the likely source is past releases of tank farm waste and not PEW or service waste.

- Chromium, tritium, and Np-237 exceed their MCL or the RBC before the year 2095 but not after 2095. Therefore, these contaminant concentrations will not pose an unacceptable risk to future residents.

- Mercury, I-129, Sr-90, and total plutonium exceed their MCLs or RBCs before 2095 (except total plutonium) and also after 2095. These contaminants are predicted to pose an unacceptable risk to the future residents (see Table 3-20).

Table 3-19. Summary of the OU 3-13 maximum and peak simulated contaminant concentrations for the entire aquifer domain[a] (DOE-ID 1997a, 1997b).

OU 3-13 COPC[b]	Sediment and Interbed K_d (cm^3/g)	MCL (mg/L or pCi/L)	1E-04 RBC	Maximum Aquifer Concentration at Year 2025 (mg/L or pCi/L)	Maximum Aquifer Concentration at Year 2095 (mg/L or pCi/L)	Peak Aquifer Concentration after Year 2095 (mg/L or pCi/L)	Peak Aquifer Concentration through Total Simulation Time (mg/L or pCi/L)
Arsenic[b]	3	0.05[c]	0.006	9.4E-05	1.2E-03	1.95E-03 (2479)[d]	1.95E-03 (2479)[d]
Chromium[b,e]	1.2	0.1[c]	0.18[f]	0.07	0.03	0.03 (2095)	0.9 (1971)
Mercury[b]	100	0.002[c]	0.003[f]	0.006	0.004	**0.004 (2095)**	**0.007 (1984)**
Total uranium[b] (inorganic)	6	0.02[c]	0.11[f]	0.003	0.001	0.01 (2468)	0.014 (1986)
Co-60	10	100[g]	254	0.03	0.0	0.0 (2095)	25.9 (1986)
Cs-137	500	200[g]	152	32.0	5.9	5.9 (2095)	86.2 (1979)
H-3	0	20,000[g]	67,100	4,240.0	89.2	89.2 (2095)	2.6E+06 (1960)
I-129	0	1[g]	26	9.0	4.68	**4.68 (2095)**	**97.1 (1986)**
Np-237[h]	8	<15	16	8.03	3.76	3.76 (2095)	30.5 (1986)
Sr-90	12	8[g]	86	35.4	8.08	**16.1 (2172)**	**1,200.0 (1967)**
Tc-99	0.15	900[g]	3,430	55.1	23.9	23.9 (2095)	203.0 (1997)
Am-241[i]	340	<15	15	00.8	0.63	0.63 (2095)	0.9 (1986)
Total plutonium	22	<15	NA	0.32	0.14	**36.2 (3585)**	**36.2 (3585)**
Total uranium	6	14	77	2.1	1	7.3 (2468)	10.1 (1986)

a. Entire aquifer domain is the area within INTEC and that which is south of the southern security fence.
b. Concentrations are provided in mg/L.
c. Drinking Water Regulations and Health Advisories, May 1995. [Note that since 1997, a new MCL for arsenic of 0.01 mg/L has been promulgated which will be in effect in 2006.]
d. Values in parentheses denote the year when the peak occurs.
e. All peak aquifer concentrations are in and downstream of the Test Reactor Area. INTEC concentrations are significantly lower.
f. Values based on hazard quotient of 1.
g. Water concentration that will result in a dose rate of 4 mrem/yr if the contaminant is the only one present, based on an ingestion of 2 L/d using International Commission on Radiological Protection-2 (ICRP-2) methods.
h. Np-237 predictions have subsequently been reduced (DOE-ID 2003b) based on revised injection well disposal estimates.
i. Am-241 numbers do not include decay from Pu-241 to Am-241 in this table.
NA – Not applicable.
NOTE: Peak aquifer concentrations highlighted in bold text indicate that the value exceeds the respective MCL.

Table 3-20. OU 3-13 groundwater ingestion cancer risk and noncancer hazard quotients in the year 2095 and for the peak concentration if it occurs beyond the year 2095 (DOE-ID 1997a, 1997b, 1998a).

Contaminant	MCL (mg/L or pCi/L)	Predicted Concentration in the Year 2095 (mg/L or pCi/L)	Groundwater Ingestion Cancer Risk in Hazard Quotient in the Year 2095	Peak Aquifer Concentration if beyond the Year 2095 (mg/L or pCi/L)	Year of Peak Aquifer Concentration	Peak Aquifer Risk or Hazard Quotient
Arsenic (mg/L)	5.0E-02	1.25E-03	2E-05 (5E-02)[a]	1.95E-03	2479	3E-05
Chromium[b] (mg/L)	1.0E-01	0.03	0.2[a]	—	—	—
Mercury (mg/L)	2.0E-03	**4.17E-03**	**1.33[a]**	—	—	—
Uranium (inorganic) (mg/L)	2.0E-02	1.31E-03	1E-2[a]	1.0E-02	2468	5.0E-01[a]
Total Am-241[c]	<1.5E+01	8.72E-01	6E-06	—	—	—
Co-60	1.0E+02	0	NA	—	—	—
Cs-137	2.0E+02	5.91E+00	4E-06	—	—	—
H-3	2.0E+04	8.92E+01	1E-07	—	—	—
I-129	1.0E+00	**4.68E+00[d]**	**2E-05**	—	—	—
Np-237	<1.5E+01	3.76E+00	2E-05	—	—	—
Total plutonium	<1.5E+01	1.39E-01	1E-06	**3.62E+01**	3585	**2E-04**
Sr-90	8.0E+00	8.08E+00	9E-06	**1.61E+01**	2172	**2E-05**
Tc-99	9.0E+02	2.39E+01	7E-07	—	—	—
Total uranium	1.4E+01	9.57E-01	1E-06	7.3E+00	2468	7E-06

a. The value given is a hazard quotient.
b. All peak aquifer concentrations are in and downstream of the Test Reactor Area. The INTEC area concentrations are significantly lower.
c. The value includes decay from Pu-241.
d. The value given is based on groundwater modeling assuming a 25-ft open interval for production well. The assumption was made in the OU 3-13 Feasibility Study Supplement (DOE-ID 1998a) that a 50-ft open interval for the same well resulted in a peak aquifer concentration of 1.41 pCi/L in the year 2106.
NA – Not applicable.
NOTE: Peak aquifer concentrations highlighted in bold text indicate that the value exceeds the respective MCL.

Contaminant discharges to the INTEC injection well are the primary contributors to the aquifer peak concentrations of mercury, I-129, Sr-90, and total plutonium (see Table 27-2 in the OU 3-13 RI/BRA [DOE-ID 1997a]). From an interpretation of the OU 3-13 RI/BRA results (DOE-ID 1997a, Section 6.6), it is possible to identify the source that led to the contaminant plumes of interest that exceed MCLs or the RBC:

- For mercury, interpretation indicates that the INTEC injection well is the main source.

- The primary I-129 flux to the aquifer was from direct input of injection well sources into the SRPA. The I-129 surface sources represent a small contribution (less than 9%) to the OU 3-13 BRA SRPA peak concentration as compared to the injection well sources of I-129.

- For Sr-90, the injection well provides most of the pre-2095 contribution, but, after 2095, the vadose zone contribution is more significant.

- For total plutonium, the injection well is the early contributor, but, later, the contribution from the vadose zone becomes most significant.

Modeling to support the OU 3-13 RI/FS indicated that tank farm contaminants released to the soil will cause unacceptable degradation of the SRPA in the future (DOE-ID 1997a, 1997b, 1998a). Specifically, estimated levels of Sr-90 and plutonium in the SRPA were predicted to exceed MCLs in years 2172 and 3585, respectively. Strontium-90 from tank farm soils was not expected to reach the SRPA for dozens of years, whereas plutonium isotopes were not expected to reach the SRPA for hundreds of years. The SRPA should not be adversely affected by tank farm Sr-90 and plutonium in the timeframe of the OU 3-13 tank farm soils interim action (DOE-ID 1999b).

3.4   Contaminant Data Review Summary

Initially, OU 3-14 was created to address release sites where available information was insufficient to select a final remedy under OU 3-13. Interim actions were developed for implementation in the OU 3-13 ROD, with the final remedy relegated to OU 3-14. The OU 3-13 ESD (DOE-ID 2004a) transferred the INTEC former injection well and three No Action soil sites outside the tank farm back to OU 3-13.

Results of the OU 3-13 RI/FS BRA (DOE-ID 1997a) showed that contaminated tank farm soil (Group 1) poses an unacceptable risk at the surface pathway. In addition, the tank farm soil and the INTEC injection well (Group 5) were determined in the OU 3-13 BRA to account for most of the contamination potentially threatening the aquifer within the INTEC security fence and were found to contribute most of the risk to future groundwater users.

The final action for the tank farm soil (Group 1) and SRPA (Group 5) within the INTEC security fence was assigned to OU 3-14 in the OU 3-13 ROD (DOE-ID 1999a), because DOE Idaho, EPA, and IDEQ determined that available or collected data from past investigations were inadequate to select remediation alternatives for the sites

3.4.1   OU 3-13 Risk Assessment Uncertainties

The OU 3-13 ROD (DOE-ID-1999a) determined that the tank farm soils represent a risk resulting from direct radiation exposure and from leaching and transport of contaminants to the SRPA within the INTEC security fence. However, significant uncertainties remaining after completion of the OU 3-13 RI/FS prevented identification of a preferred remedial alternative. The work scope presented in this Work

Plan is based in part on the risk assessment uncertainties identified in the OU 3-13 BRA and ROD related to the extent, distribution, and composition of contamination present in the tank farm soils and the extent of contaminant transport from the soils to the SRPA within the INTEC security fence. This section summarizes those identified uncertainty issues. The data collection activities presented in Section 4 are designed to address these issues.

3.4.1.1 Uncertainties in the Evaluation of Direct Exposure to Surface Soil Contamination.

The magnitude of risk from surface exposure is large enough that the addition of small sites containing less than 1% of the tank farm inventory of radionuclides will not significantly affect this risk pathway. In addition, because the risk is well above the levels that drive remediation, further refinement of this risk serves no purpose. Uncertainties in evaluation of risk due to direct exposure to surface soil contamination are relatively small. Resolution of these uncertainties will not affect the need for remediation or the type of remedial action selected.

3.4.1.2 Uncertainties in the Evaluation of Risk from the Groundwater Pathway.

Prediction of the exposure to contaminants in groundwater is based on numerical modeling of contaminant transport. The OU 3-13 ROD (DOE-ID 1999a) determined that the SRPA within the INTEC security fence might represent a risk to future groundwater users. Operable Unit 3-13 BRA risk estimates (DOE-ID 1997a) associated with predicted concentrations in the SRPA were deemed by the Agencies to be unacceptable because of modeling uncertainties. Therefore, a final remedial alternative for the SRPA within the INTEC security fence was not selected in the OU 3-13 RI/FS (DOE-ID 1997a, 1997b, 1998a). The uncertainties in the groundwater modeling that affect the calculated risk are discussed below.

A major factor in accurate prediction of contamination in the SRPA is the transport of contaminants through the vadose zone. This is especially important in terms of velocity of travel through the vadose zone for radionuclides with relatively short half-lives such as Sr-90, because the vadose zone travel time is roughly the same order of magnitude as half-lives and uncertainty is increased because the predicted concentrations are very sensitive to travel time and recharge rates that are higher than background. Several factors affect transport time through the vadose zone. These factors include the following items:

- Transport Time through Surface Sediments to Basalt—The OU 3-13 BRA assumed that contaminants from tank farm soils were all instantaneously present at the top of basalt, and that there was no retention of contaminants in the tank farm soils. This was assumed because almost all of the liquid released to the tank farm soils was very acidic, the large amount of hydrogen ion may reduce sorption, and many sites are located deep in the surface alluvium near the basalt. An alternative approach is appropriate, because sufficient carbonates are present in the alluvium soil to neutralize the acid.

- Location and Thickness of Interbeds in the Vadose Zone—The OU 3-13 RI/BRA numerical model simplified the vadose zone by combining the 13 or more interbeds into four effective interbeds separated by fractured basalt. The effective interbed structure was much more continuous than the observed structure, and the model predicted percolation pond water would spread laterally and recharge the perched water beneath the tank farm. The INTEC vadose zone tracer test and geochemical analysis (DOE-ID 2003a) indicate this may not be occurring. Additional data from Group 4 perched water investigations are available for a more accurate depiction of the interbeds and parameterization of the hydraulic properties.

- K_ds for COCs Sr-90 and Pu-239/240 in the Vadose Zone—The K_ds used in the OU 3-13 BRA were extremely conservative (low), were based on the Track 2 guidance documents, and did not account for the demonstrated buffering capacity of tank farm alluvium. Additional K_d data for these

constituents in INEEL soils has been obtained since the OU 3-13 BRA modeling. The impact of K_d on the transport time for Sr-90 is very significant, because the half-life of Sr-90 (30 years) is relatively short, and the amount of Sr-90 predicted in the SRPA can vary by orders of magnitude with small changes in the K_d, which strongly affects Sr-90 vadose zone travel times. The impact of K_d on the transport time of Pu-239/240 is also very significant, because the modeled risk from plutonium is within an order of magnitude of acceptable risk, and because the complex chemical nature of Pu makes it challenging to identify a single, appropriate K_d. The plutonium K_d used in OU 3-13 was 1 to 3 orders of magnitude smaller than the K_d used for vadose zone transport at other INEEL OUs, and the literature indicates that higher values are justified. More detailed discussion on K_ds can be found in Section 4.1.4.

- Surface Recharge Rate—Infiltrating water moving down through the contaminated soils, mobilizing contaminants and eventually transporting them to the SRPA, is one of the most realistic scenarios for aquifer contamination beneath the INTEC. Therefore, infiltration is an important factor controlling contaminant migration, because infiltration is primarily responsible for the amount of dissolution and transport of contaminants from the contaminated tank farm soil. The OU 3-13 analysis used infiltration rates estimated at the INEEL's Subsurface Disposal Area, where soil and surface conditions are very different from the tank farm.

- Source Term Uncertainty—The knowledge of the nature and extent of contamination in the tank farm soils is partially bounded by existing data. Due to the high radiation fields associated with the contaminated soils, analysis of the soils has been difficult. However, the two sites that make up 99% of the known tank farm contamination have been defined. The further definition of small sources (1% of the total contamination) likely will not have a major impact on the need for remediation of groundwater or the type of remediation selected.

3.4.2   Tank Farm Soil Contaminants of Potential Concern

This section presents the approach that will be used to identify tank farm soil COPCs. COPCs may be identified based on potential risks to human health and the environment or based on ARARs. The conceptual approach for identifying COPCs for specific sites is described below and shown in Figure 3-44:

1. Potentially complete exposure pathways for OU 3-14 are identified in the conceptual site model (CSM) shown in Figure 3-45. These include direct soil exposure to future workers on the tank farm and potential groundwater exposure inside the INTEC security fence line.

2. The COPCs for those exposure pathways are identified based on screening results reported in the OU 3-13 RI/BRA report (DOE-ID 1997a), as discussed in Section 3.3 of this Work Plan and as identified in Tables 3-17 and 3-18 for soil exposure and groundwater exposure pathways, respectively. COPCs identified subsequent to publication of the OU 3-13 BRA, nitrate and C-14, are included because these are known constituents of the tank farm waste.

3. The COPC list is used as an input to the DQO process. The DQO process, as described in Section 5, is used to design the field investigation. DQO Step 2 describes the approach used to determine the required rigor of the investigation at specific sites, based on the estimated fraction of total tank farm contamination released that is estimated to be present at a specific site. In DQO Step 7, some sites are determined on this basis to have sufficient data to adequately resolve the DQO decision statements and to require no further characterization for COPCs.
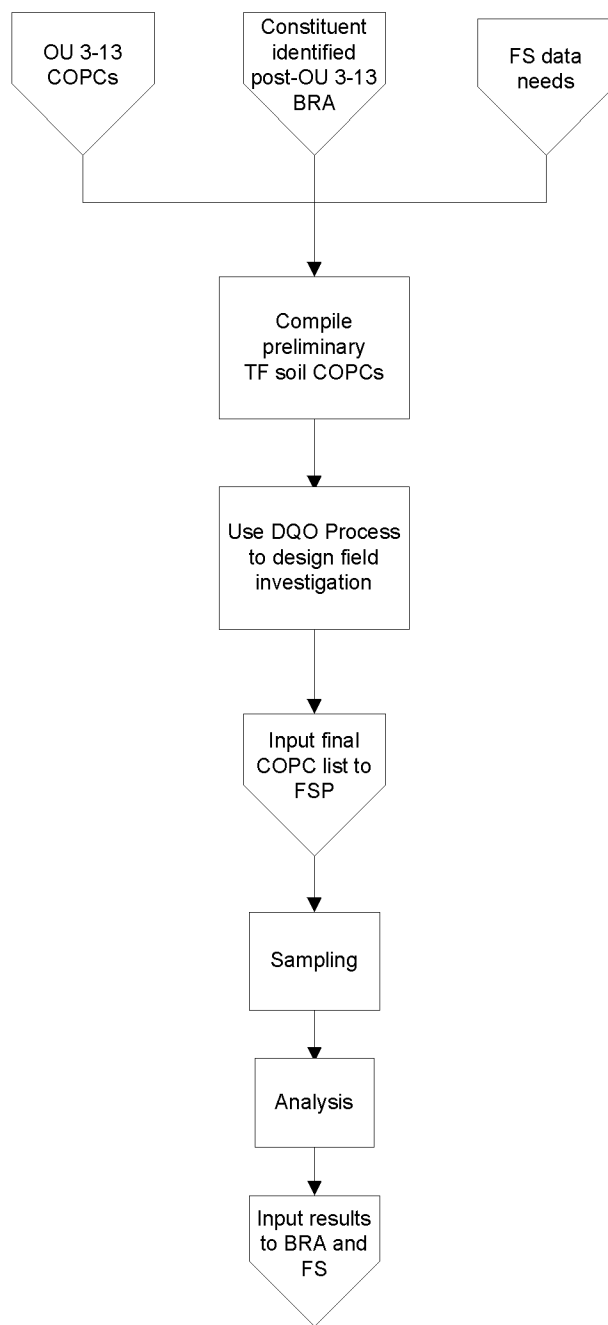
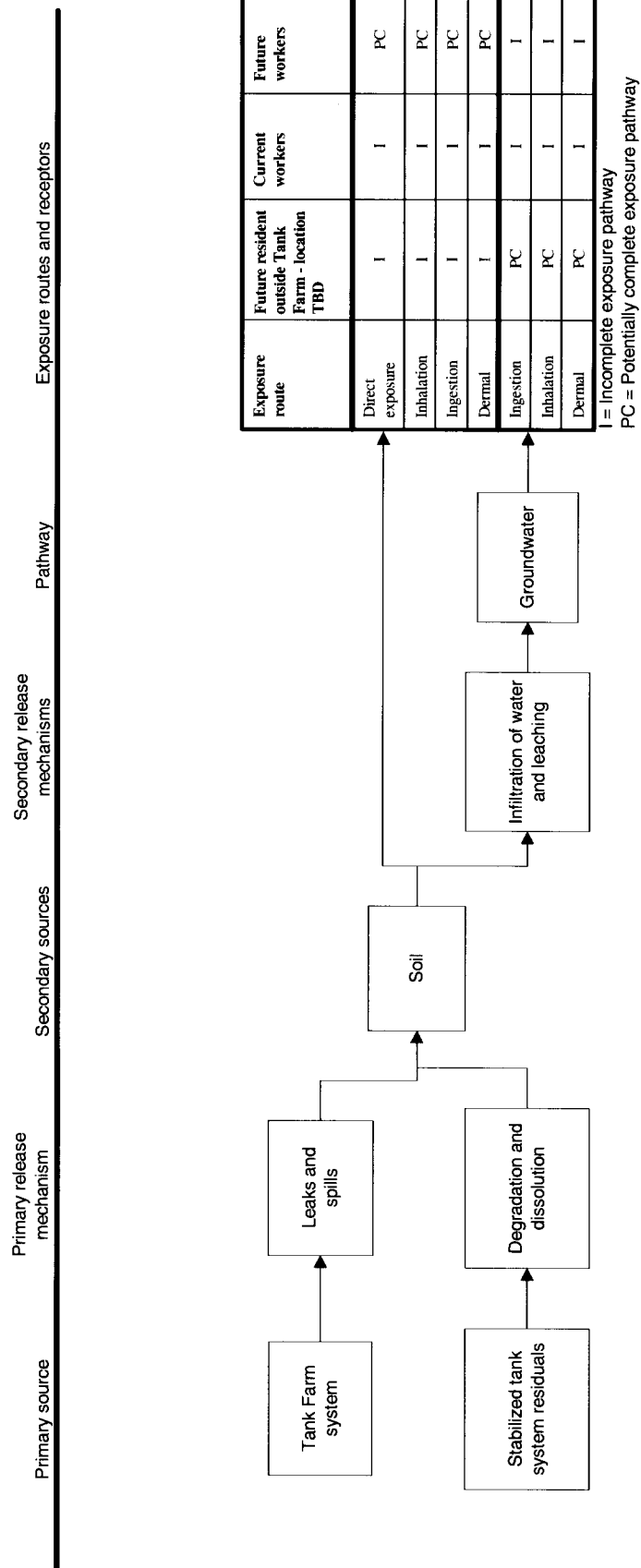Figure 3-44. Decision logic for tank farm soil COPC identification.

Primary source   Primary release mechanism   Secondary sources   Secondary release mechanisms   Pathway   Exposure routes and receptors

Exposure route	Future resident outside Tank Farm - location TBD	Current workers	Future workers
Direct exposure	I	I	PC
Inhalation	I	I	PC
Ingestion	I	I	PC
Dermal	I	I	PC
Ingestion	PC	I	I
Inhalation	PC	I	I
Dermal	PC	I	I

I = Incomplete exposure pathway
PC = Potentially complete exposure pathway

Tank Farm system → Leaks and spills → Soil

Stabilized tank system residuals → Degradation and dissolution → Soil

Soil → Infiltration of water and leaching → Groundwater

Figure 3-45. Conceptual site model for OU 3-14.

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4. FS data needs, including waste characterization information and technology-specific information, are input to the DQO process.

5. The results of the DQO process identifying specific sites to be sampled for the tank farm COPCs are used as inputs to the FSP.

6. Samples are collected for analysis.

7. Results are used as input to the BRA and FS.

Preliminary COPCs, waste characterization, and technology-specific information, required to be determined for specific sites to meet BRA and FS data needs are shown in Table 3-21.

3.4.3   OU 3-14 BRA COPC Screening

Additional COPC screening will be performed during the OU 3-14 BRA using the approach outlined in DOE-ID (1997a) and discussed below.

3.4.3.1   Background Comparison. The chemical will be eliminated from quantitative evaluation in the RI/BRA if the maximum concentration for a given chemical is less than or equal to background concentrations (i.e., the 95/95 upper tolerance limit of composite background samples) as presented in *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (Rood et al. 1995).

3.4.3.2   Concentration-Toxicity Evaluation. The objective of a concentration-toxicity screen is to identify the chemicals that are based on concentration and toxicity and are most likely to contribute significantly to risks. The inputs used in this screening step include the inherent toxicity of individual chemicals and the maximum detected concentrations at specific release sites (EPA 1989). Toxicity values used to calculate individual risk factors are slope factors (SFs) for carcinogens or the reciprocal of the reference dose (1/RfD) for noncarcinogens as shown in Equation (3-1). Thus, the risk factor for carcinogenic effects is the maximum detected concentration (or activity) multiplied by the SF for that chemical. The risk factor for noncarcinogenic effects is the maximum detected concentration divided by the RfD for that chemical:

$$R_i = C_i \, H \, T_i \tag{3-1}$$

where

R_i =   chemical-specific risk factor for chemical

C_i =   maximum detected concentration of chemical

T_i =   toxicity value (either the SF or 1/RfD) for chemical.

For chemicals with separate oral and inhalation toxicity values, the most conservative value is used in the concentration-toxicity screen step. Chemicals without EPA-derived toxicity values cannot be screened out by this procedure, nor can specific health risks be estimated quantitatively. As a result, such chemicals will remain COPCs and will be discussed qualitatively in the uncertainty analysis. Radionuclides were not subject to the concentration-toxicity screen step.

Table 3-21. Preliminary summary of COPCs and analytical methods required to meet data needs for OU 3-14 tank farm soil release sites.

Category	Analyte	Method
Radionuclides	Am-241	Alpha spec or gamma spec
	Pu-238	Alpha spec
	Pu-239/240	Alpha spec
	U-233/234	Alpha spec
	U-235	Alpha spec or gamma spec
	U-238	Alpha spec
	Np-237	Alpha spec
	H-3	Liquid scintillation counter
	Tc-99	Liquid scintillation counter
	Sr-90	Gas proportional counter
	C-14	Gas proportional counter
	I-129	Gas proportional counter or gamma spec
	Cs-137	Gamma spec
	Eu-154	Gamma spec
Inorganics		
	Arsenic	SW-846[a] 7000A[b] or 7062[c]
	Chromium	SW-846 6010/6010B[d]
	Mercury	SW-846 7470A[e] (aqueous) or 7471A[f] (non-aqueous)
Wet Chemistry	Nitrate-N	EPA-300.0[g], 352.1[h], 353.1[i], or 353.2[j]
	Nitrite-N	EPA-300.0[g], 352.1[h], 353.1[i], or 353.2[j]
	pH	SW-846 9045C
	Acidity	Method 12.3 (Page et al 1982)
Organics	Appendix IX TAL-VOCs	SW-846 8260B[k]
	Appendix IX TAL-SVOCs	SW-846 8270C[l]
TCLP	Metals and organics	SW-846 1311[m]

SVOC = semivolatile organic compound.
TAL = target analyte list.
TCLP = toxicity characteristic leaching procedure.
VOC = volatile organic compound.
a. All SW-846 methods cited in this table are extracted from "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA 2003).
b. SW-846, Method 7000A, "Atomic Absorption Methods."
c. SW-846, Method 7062, "Antimony and Arsenic (Atomic Absorption, Borohydride Reduction."
d. SW-846, Method 6010/6010B, "Inductively Coupled Plasma-Atomic Emission Spectrometry."
e. SW-846, Method 7470A, "Mercury in Liquid Waste (Manual Cold-Vapor Technique)."
f. SW-846, Method 7471A, "Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)."
g. EPA Method 300.0, "Determination of Inorganic Anions by Ion Chromatography" (EPA 1993).
h. EPA Method 352.1, "Nitrate (Colorimetric, Brucine)" (EPA 1983).
i. EPA Method 353.1, "Nitrate-Nitrite (Colorimetric, Automated Hydrazine Reduction)" (EPA 1983).
j. EPA Method 353.2, "Nitrate-Nitrite (Colorimetric, Automated Cadmium Reduction)" (EPA 1983).
k. SW-846, Method 8260B, "Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry."
l. SW-846, Method 8270C, "Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry."
m. SW-846, Method 1311, "Toxicity Characteristic Leaching Procedure."

To avoid eliminating chemicals prematurely, the concentration-toxicity evaluation for WAG 3 will be implemented on a basis that is specific to the contaminant group (i.e., inorganics and organics). Chemicals having carcinogenic and noncarcinogenic effects within the inorganic and organic groups are evaluated separately. Some analytes, such as arsenic, have both noncarcinogenic and carcinogenic effects and, as a result, are included in both the carcinogenic and noncarcinogenic screens.

After calculating individual chemical risk factors, they are summed to obtain the total risk factor (Rj) for all chemicals in a medium. Individual chemical risk factors will then be divided by the total risk factor to derive a chemical-specific ratio (Ri/Rj), which provides an index of the relative risk contributed by each chemical. All chemicals that contribute less than 1% (ratio of 0.01) of the overall risk factor will be eliminated from quantitative consideration in the RI/BRA. Consequently, chemicals advanced into the quantitative risk assessment will represent the COPCs expected to provide the most significant contribution to the risk at a particular site.

3.4.3.3 *Comparison Against Risk-Based Concentrations.* The last step in the chemical screening process is to compare COPC concentrations to RBCs. The comparison is limited to metals, inorganics, and organics. If the maximum concentration or 95% upper confidence level (UCL), whichever is less, for a given chemical is less than or equal to the most conservative RBC, as presented in the most current EPA Region 9 Risk-Based Concentration Table, the chemical will be eliminated from quantitative evaluation in the RI/BRA.

Because lead does not have an EPA Region 9 RBC, lead concentrations will be compared to the residential soil screening level of 400 mg/kg, as presented in EPA (1994).

3.5 Conceptual Site Model for Risk Assessment

This section discusses development of the OU 3-14 CSM, based on the site features and characteristics discussed previously, and the risk assessment summary presented in Section 3.2. The purpose of the CSM is to identify site-specific contaminant sources, exposure pathways, and receptors. The CSM is then used to do the following:

- Develop DQOs. The CSM is used to help define the principal study questions (PSQs) that the field investigation must help resolve (e.g., "Does a specific exposure pathway produce risks to a specific receptor above allowable levels?). The CSM is also used to help define decision inputs, define study boundaries, and design the investigation.

- Evaluate risks. The BRA uses data obtained from the field investigation and other sources to determine whether exposure pathways shown in the CSM are potentially complete and to quantitatively evaluate risks for each.

- Develop and evaluate remedial alternatives. The CSM helps to identify ways to reduce risks to allowable levels, including sources that can be removed or treated, exposure pathways and routes that can be eliminated or controlled, and receptors that can be protected through administrative controls.

3.5.1 Contaminant Sources and Pathways

This section introduces the OU 3-14 conceptual model, which combines the site physical, chemical, and hydrologic features in the context of contaminant transport from sources to receptors. In addition, this section discusses the OU 3-14 CSM, which is based on the conceptual model and the risk

assessment summary presented in Section 3.2. The conceptual model is further developed and discussed in detail in Section 4 of this Work Plan.

Features of the OU 3-14 conceptual model are shown in Figure 3-46. Significant features include the following:

- The INTEC facilities, which include the tank farm and other primary contaminant sources.

- The alluvium underlying the INTEC facilities, which is a secondary contaminant source resulting from leaks and spills from the liquid waste transfer system.

- The basalts, interbeds, and perched water underlying the alluvium. The physical and chemical properties of these media control contaminant transport rates from the secondary sources to the SRPA, as discussed in Sections 3 and 4.

- The SRPA underlying the INTEC. Given that the basalts, interbeds, and perched water are not accessible to human or environmental receptors, the SRPA is a potential primary exposure route of concern.
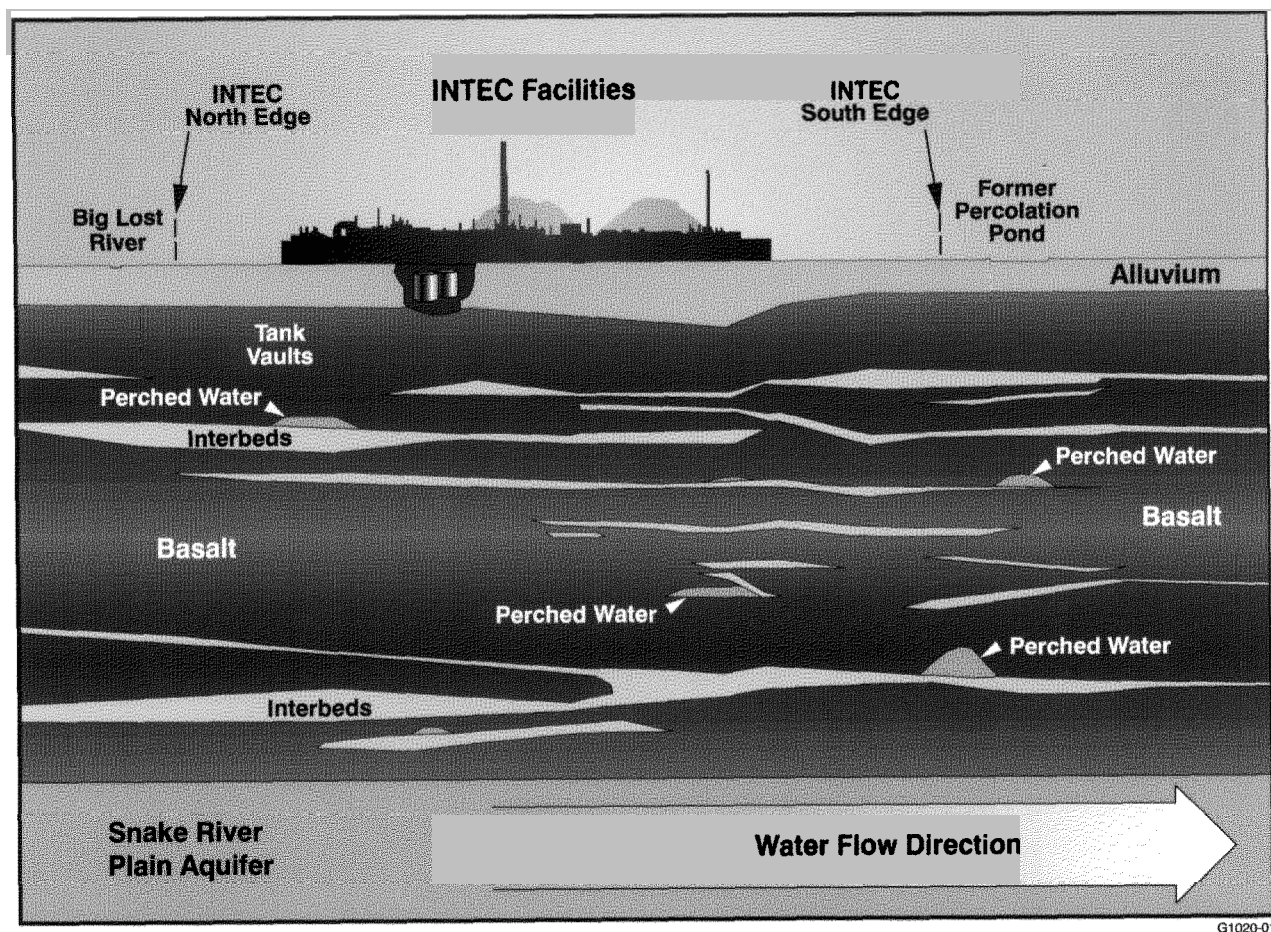

Figure 3-46. INTEC conceptual model features.

3.5.2 Surface Soil Exposure Routes and Receptors

Figure 3-45 identifies incomplete and potentially complete exposure pathways for current workers, hypothetical future workers at the tank farm, and hypothetical future receptors for groundwater inside the INTEC security fence. Future workers are the only potential surface soil exposure pathway receptors for the tank farm, based on future land use assumptions described in Section 5.1.3. Future residents would be prohibited from accessing the tank farm in perpetuity, as described in Section 5.1.3.

Workers after 2095 could potentially occupy the site under industrial-use scenarios and excavate no deeper than 4 ft bgs to construct footings or other infrastructure supports. Exposure to soils contaminated by releases of liquid waste from the tank system could occur through direct exposure to radiation ingestion, dust inhalation, or dermal contact. Workers would not be exposed to stabilized tank residuals, since these are located below the 4-ft maximum depth of excavation, with adequate shielding provided by overlying soil to prevent direct radiation exposures above allowable levels.

3.5.3 Groundwater Exposure Routes and Receptors

Figure 3-45 identifies only future residents as potential groundwater exposure pathway receptors, based on future land use assumptions. The maximally exposed future resident would reside no closer than the tank farm fence at a location to be determined and would potentially be exposed to contamination from the tank farm via culinary or irrigation water obtained from a well completed in the SRPA at that location.